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I, Livia Cheung, hereby certify that the following is, to the best of my knowledge and belief, a true and accurate translation of this document, "Hydraulic Inorganic Composition – S60-171260", from Japanese into English.

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Sworn to before me this

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(54) Title of the invention HYDRAULIC INORGANIC COMPOSITION

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SPECIFICATION

1. Title of the Invention

Hydraulic inorganic composition

2. Scope of Patent Claims

A hydraulic inorganic composition that is characterized in that it comprises,

a) 10 - 90 parts by weight of a hydraulic cement,

b) 10 - 90 parts by weight of a hydraulic gypsum,

c) 17 - 25 parts by weight of water (including the moisture contained in the acryl water-dispersing organic polymer of d),

d) 2 - 16 parts by weight of an acrylic, water-dispersing organic polymer that has a moisture-reducing effect (solid portion converted), and

e) 0.5 - 2.0 parts by weight of a moisture-reducing agent.

3. Detailed Description of the Invention

The present invention relates to a hydraulic inorganic composition that realizes water resistance and high strength without the occurrence of deformation or cracking and that permits thin, hardened bodies with large dimensions to be formed easily.

Conventionally, inorganic products that are manufactured of cement, gypsum, or clay or that are manufactured of a compound in which an organic polymer or inorganic compound is combined with an inorganic composition already exist, but items manufactured of cement have the disadvantage that they are subject to low fracture toughness, low flex strength, occurrence of efflorescence, occurrence of constriction cracking, slow strength manifestation, etc. In addition, items manufactured of gypsum have the disadvantage that they have a low mechanical strength and are poor in water resistance and items manufactured of clay have the disadvantage that they must be fired at high temperatures to produce a high mechanical strength and that production yields are low as a result of deformation and cracking in the drying and firing stages. Moreover, inorganic products in which a water-dispersing organic polymer has been compounded with a cement - gypsum composition have been developed frequently in the prior art, but almost all of these have been poor in mechanical strength and water resistance, and the manufacture of those that have attained a fairly high strength (a flex strength of 200 kg/[illegible] or greater) and water resistance has required [illegible] stages such as autoclave treatment, pressing, or coating by UV or [illegible]B treatment as well as large facilities and equipment. This has presented problems with manufacturability or economy.

Thus, the easy manufacture of products that hardened items that have high strength and water resistance, and especially, products that are thin and have large dimensions has been extremely difficult.

The inventor has devised the present invention has solved the problems of conventional inorganic products described above by, in order to make the air bubble ratio and air bubble diameter in the hardened material as small as possible, (1) maintaining the fluidity of the slurry and holding the volume of mixed water [illegible] to a volume extremely close to the [illegible] water content or [illegible] water content by using an acryl water-dispersing organic polymer that has moisture-reducing and water-dispersing effects (2) generating ettringite fibers to further reduce water and filling the spaces in the hardened material with these crystals, and (3) by using a mixture of hydraulic cement and hydraulic gypsum to realize their mutually complementary effects. And has found that it demonstrates superior water resistance and strength.

That is to say, the inventor has provided the present invention that is a hydraulic inorganic composition that is characterized in that it comprises a) 10 - 90 parts by weight of a hydraulic cement, b) 10 - 90 parts by weight of a hydraulic gypsum, c) 17 - 25 parts by weight of water (including the moisture contained in the acryl water-dispersing organic polymer of d)), d) 2 - 16 parts by weight of an acrylic, water-dispersing organic polymer that has a moisture-reducing effect (solid portion converted), and e) 0.5 - 2.0 parts by weight of a moisture-reducing agent.

The hydraulic cement according to the present invention may be a Portland cement, aluminate cement, white cement, blast furnace slag cement, silica fume cement, and so forth, commonly used in engineering construction, and may be used singly or in some combination thereof. The hydraulic gypsum may be a calcined gypsum (alpha form or beta form) or anhydrous gypsum and may be used singly or in some combination thereof. The ratio by weight of hydraulic cement to hydraulic gypsum is in the range 10 : 90 - 90 : 10, but when the hydraulic cement is less than 10 parts by weight or when the hydraulic gypsum is less than 10 parts by weight, the properties that are the objective of the present invention cannot be obtained, and especially, cracking, etc. has been observed when the hydraulic cement is greater than 90 parts by weight.

The water-dispersing organic polymer according to the present invention refers to a polymer in which minute particles are dispersed homogeneously in water and which forms a so-called [illegible] latex or emulsion, and may be, broadly classified, a vinyl acetate, an acryl, a chlorine-containing vinyl polymer, a compound rubber, etc. However, when mixed with a hydraulic inorganic material, an acryl is preferred because it does not reduce the fluidity of the mixture and it produces a water-reducing effect, yet it still generates high strength, water resistance, etc., in the hardened material. In other words, copolymers of an acrylate ester and a methacrylate ester are indicated as the acryl water-dispersing organic polymer, but this includes copolymers that contain approximately one half or more of an acrylic monomer. Of these, a material that generates a water-reducing effect and maintains the fluidity of the slurry, that has a high film strength, and that is superior in water resistance, alkali resistance, [illegible] resistance, and polish is preferred, specifically methyl methacrylate-2-ethylhexylacrylate, styrene-butyl acrylate, etc. Here, to obtain the required water resistance and high strength, the amount of [illegible] water is reduced as much as possible to approach the theoretical moisture content, but this can be accomplished by mixing moisture-reducing agents with these acryl water-dispersing organic polymers that possess moisture reducing properties. However, little improvement in water resistance and strength, etc., is observed when the amount of acryl water-dispersing organic polymer used is 2 parts by weight or less. In addition, volumes of 16 parts by weight or more are disadvantageous from the viewpoint of cost, and since no improvement in strength is observed, the volume of acryl water-dispersing organic polymer with moisture-reducing effect that is used is in the range 2 - 16 parts by weight, preferably 4 - 12 parts by weight (both converted to solids), with respect to 100 parts by weight of a mixture of hydraulic cement and hydraulic gypsum. In this way, since the dispersibility of the mixture of hydraulic cement and hydraulic gypsum is improved and the moisture-reducing effect and strength appearance in the hardened material are further improved, a moisture-reducing agent for general cement use is used. Specific examples are sodium lignin sulfonate, sodium salts of melamine sulfonate formaldehyde condensate, sodium salts of β-naphthalene sulfonate formaldehyde condensate, sodium salts of creosol sulfonate formaldehyde condensate, etc., but sodium salts of melamine sulfonate formaldehyde condensate are most preferred.

The amount to be added is in the range 0.5 - 2.0 parts by weight, preferable 0.5 - 1.0 parts by weight, with respect to 100 parts by weight of the mixture of hydraulic cement and hydraulic gypsum.

An amount of mixed water that is the theoretical volume of water or is extremely close to the theoretical volume of water is sufficient and is in the range 17 - 25 parts by weight, preferably 17 - 20 parts by weight, with respect to 100 parts by weight of the mixture of hydraulic cement and hydraulic gypsum, but this includes the water content of the acryl water-dispersing organic polymer, and ac cording to the amount of acryl water-dispersing organic polymer used, the water content of this may be sufficient and the addition of water is unneeded, and even when needed, the amount of water added is up to a maximum of 15 parts by weight. Note that, even with 17 - 25 parts by weight of water, fluidity of the slurry is sufficiently maintained, foaming and defoaming is easy, poured shapes can be formed easily. The reason is that, with a water volume of less than 17 parts by weight, the amount of water required for hydrophilia with the hydraulic materials is insufficient, and with a volume of more than 25 parts by weight, the amount of water is excessive and sufficient physical characteristics cannot be obtained.

In the present invention, strengthening agents, fillers, etc., can be added to further improve the physical characteristics of the hardened material. Strengthening agents used may be inorganic materials such as glass fibers, slag fibers, rock wool, asbestos, etc., organic materials such as polypropylene, vinyl polychloride, polyester, polyamide, etc., fibrous strengtheners from woody fibers such as pulp, used paper, sawdust, flax, cotton, etc., or fine particle diameter powder strengtheners such as carbon black, aluminum hydroxide, calcium carbonate, magnesium carbonate, white carbon, titanium dioxide, etc. The volume of these strengtheners is in the range 0.5 - 10 parts by weight with respect to 100 parts by weight of the mixture of hydraulic cement and hydraulic gypsum. Additionally, fillers may be talc, mica, barite, [illegible] powder, etc. Further, suitable amounts of publicly known defoaming agents, hardening accelerating agents, hardening slowing agents, water-repelling agents, water-resisting agents, coloring agents, etc., may be added as needed. Moreover, the surfaces of hardened items formed from the water-dispersing inorganic composition according to the present invention may be treated with hard coating materials such as silicon or ceramic coating materials to form a membrane film that will further improve dirt resistance, abrasion resistance, damage resistance, chemical resistance, contaminant resistance, polish, water resistance, etc.

When manufacturing a hardened item from the water-dispersing inorganic composition according to the present invention, the fluidity of the slurry is very good, despite the low volume of water content, and foaming and defoaming can be conducted easily. As a result, items can be formed by pouring after excitation defoaming methods that add a defoaming agent and use a table vibrator or vacuum stirring foaming methods have been used. This slurry is self-leveling, so that the formation of flat items is especially easy. Hardened items removed from molds can be heated at 60 - 100°C for four hours or more following natural [illegible] in a humid environment. When an acryl water-dispersing organic polymer that cannot be formed at normal temperatures is used, heating to the range of minimum forming temperature to 100°C is needed.

The water-dispersing inorganic composition according to the present invention does not require large scale facilities and equipment and hardened items can be obtained very easily at low cost and can be made into thin shapes with especially large dimensions. Moreover, these hardened items have high strength, are excellent in water resistance, incombustibility, dirt resistance, vibration absorption, etc. Moreover, it is characterized in that yields are high due to almost no deformation or cracking during manufacture and shape reproducibility is extremely good because swelling and shrinkage is extremely small. In addition, it has the effect that hardened items with extremely high polish can be obtained when molds with mirror surfaces are used.

Accordingly, the water-dispersing inorganic composition according to the present invention can be used widely as a engineering material such as tiles, blocks, paving stones, [illegible], interior and exterior [illegible] wall materials, flooring materials, ceiling materials, platform materials, interior materials, novelties, sound materials, vibration-absorbing materials ([illegible] materials), etc.

Next, the present invention will be further explained using embodiments. Note that for flex strength tests, specimens were formed with the dimensions 40 x 160 x 8 [illegible], and the test equipment used was a Shimazu Engineering Co., Ltd. Model *IS*500 autograph. Tests were conducted in accordance with JIS standards.

Embodiment 1

One part by weight (hereafter simply called "part") of a powdered water-reducing agent (a sodium salt of melamine sulfonate formaldehyde) was dissolved beforehand in 5 parts of water. To this, 20 parts of an ester acrylate copolymer emulsion (converted solids, 8 parts) were added to form an aqueous paste.

To this was added a mixture of 20 parts of α form calcined gypsum, 80 parts of Portland cement, and 3 parts of glass fibers (chopped strands). The resulting solution was agitated and stirred at 550 rpm for 5 minutes (during this period, a suitable volume of a silicon defoaming agent was dripped into the solution) to obtain a slurry with excellent fluidity. This slurry was defoamed on a table vibrator for 5 minutes and was then poured into a plastic mold with a mirror surface and was hardened. Following hardening and removal from the mold, the material was [illegible] at normal temperature, and was then heated for 4 hours at 70 - 75°C, and further, for 30 minutes at 90 - 95°C. This hardened item had a high polish, its flex strength was 306.5 kg/[illegible], and its absorbed water ratio (after submersion for 24 hours) was 0.51%.

Embodiment 2

A slurry produced in the same manner as Embodiment 1 was poured into a glass [illegible] with the dimensions 440 x 500 [illegible] to a depth of 5 [illegible] to obtain a hardened item. When the item was [illegible] and heated under the same conditions as Embodiment 1, there was almost no swelling or shrinkage and no deformation or cracking, so that a high strength, high polish product with large dimensions was obtained.

Embodiment 3

0.5 parts of a powdered water-reducing agent (a sodium salt of melamine sulfonate formaldehyde) was dissolved beforehand in 5 parts of water. To this, 20 parts of an ester acrylate copolymer emulsion (converted solids, 8 parts) were added to form an aqueous paste. To this was added a mixture of 60 parts of α form calcined gypsum, 40 parts of aluminate cement, 5 parts of carbon black, and 3 parts of glass fibers (chopped strands). The resulting solution was agitated and stirred at 550 rpm for 5 minutes (during this period, a suitable volume of a silicon defoaming agent was dripped into the solution) to obtain a slurry with excellent fluidity. After pouring, defoaming, [illegible], and heated in the same manner as Embodiment 1, the material flex strength was 268.2 kg/[illegible], and its absorbed water ratio (after submersion for 24 hours) was 0.55%.

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